Build a replica of the Paraset or Type VII set

An early WW2 transceiver of the British Secret Service and used by the SOE.

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1. Introduction

In the mid 1990s I discovered a book by Pierre Lorain [1] on clandestine equipment used during WW II.

Amongst the collection of transceiver sets, was a simple compact set called the Paraset and from the drawings and circuit outline given it looked possible to reverse engineer and build one.

Although work commenced then, time was needed to collect the necessary components from that era and thus the set was only completed late 2004.

In this article sufficient details are supplied so that other working replicas can be constructed. The completed replica is shown in Figure 1.

2. History

The Type VII set was developed by the Special Communications Group of MI6 at the outset of the war [2, 3] and was used by various clandestine operations including the SOE (Special Operations Executive) in Europe. It was even used by agents at the time of the Normandy landing.

The set, housed in a steel case, has a two valve regenerative receiver covering in one band the frequencies 3 to 8 MHz. The single valve crystal controlled 4 watt transmitter covers a slightly narrower frequency range in two bands, 3.2 to 7.6 MHz. Consequently the set will operate on both the 80 metre and 40 metre amateur bands.

It is easy to tune having a tank circuit and aerial circuit capacitor that are adjusted for maximum brightness of two lamps. The power supply is a separate unit, supplying 6.3 V at 1.1 A for filaments and a high tension of typically 250 V at 50 mA.

While several versions of the set were produced during WW II, the Paraset described here is based on the material given in reference [1].

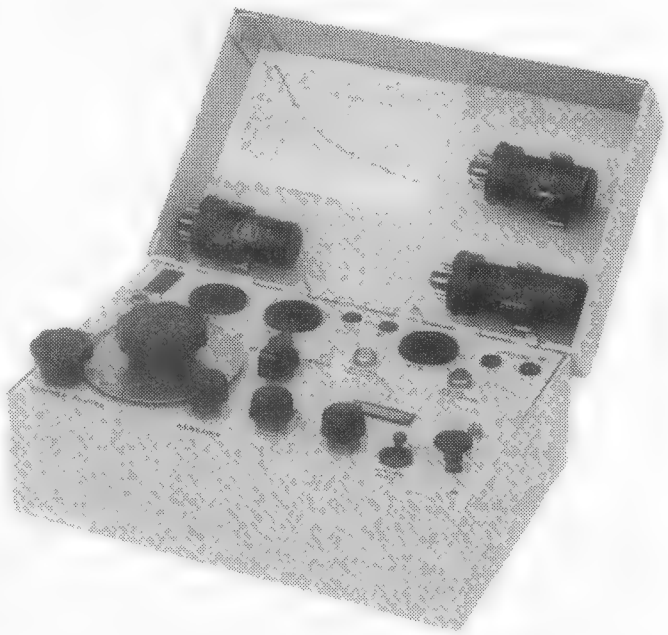


Figure 1. The Type VII or Paraset transceiver replica

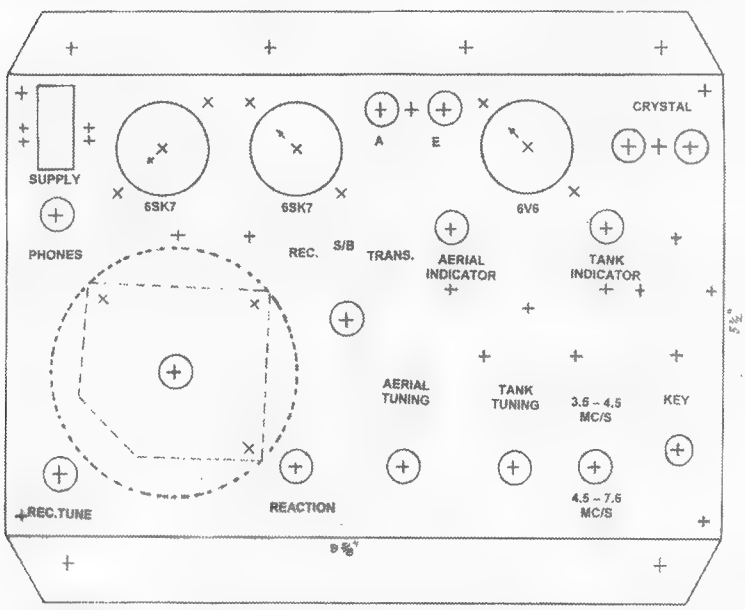


Fig 3 Layout of the operating face of the set (not scale, see Note 1)

3. The mechanical construction

Figures 3 and 4 shows the construction (Note 1). The box is made from 18 gauge zinc plated steel sheet, folded and spot welded.

A 7 ½" long piano hinge across the back allows the lid to open and close. Note the recess for the hinge and the holes drilled must match the hinge selected. The lid is slightly larger than the box so when closed it overhangs the box.

If access is not available to a spot welder then split or pop rivets can be used, and in the case of the latter filling the central hole with plastic steel so when painted, they look like an old style rivet.

An alternative would be to use a wooden case without a hinged lid, which is how the early Parasets were packaged. The top panel would also have been made from zinc steel, however I chose to use 16 gauge annealed aluminium, a material much easier to work with in a home workshop.

The panel has a bent right angle portion at both the top and bottom and this gives additional rigidity so when plugging in and removing the valves the panel does not distort or deflect.

These vertical sections also provide the mounting points to the case, via attached flush fitting bushes such as "Nutserts" or "Prestincerts" fixed to the fold down sections of the top panel.

Should spot welding facilities not be available then the piano hinge can be clamped into place by these screws (4?) into the back "nutserts". Before drilling any of the holes (mounting tag strips and coils, power plug, variable capacitors, etc) make sure they are in the correct position for the particular components you have collected.

The Morse key can be improvised in a number of ways. I used a conventional style one, adapted and mounted upside down. Figure 5 shows the principle. Lamp holders were taken from an old B/C set dial, the globes replaced with screw style 2.5V torch globes. The aerial and earth terminals are a crystal socket holder, matching the one used for the transmitter crystal.

The valves are mounted in the lid using modified spring tool clamps. Those currently available in hardware stores may be too long and need to have the ends trimmed back.

4. The circuit

Both transmitter and receive circuits are standard configurations. Most components are non critical (remember in WW II components were 20% tolerance) and in several cases a range of values that can be used is indicated on the circuit diagram.

A problem with capacitors is the DC working voltage is high and 400 V or 600 V ratings are preferred to 250 V. In many cases I employed old mica capacitors and carbon composition resistors (of ½ watt rating) to give the set the appearance of being authentic.

With some capacitor values this was not possible and knowing that many WW II capacitors had a black outer coating I simply painted the more modern components black.

One significant problem was the transmitter toggle switch that switches in the parallel 100 pF capacitor on the lower frequency band.

All of the old style WW II toggle switches I had access to had high contact resistances (switches built for switching high voltages at low currents) and eventually I had to use a more recent variety.

The spacing of the transmitter tank and aerial tuning condensers prevents the use of many B/C set styles and good quality slim ceramic insulation style ones are required. One of the capacitors I acquired was 150 pF rather than 100 and this I used as the aerial tuning capacitor.

With the receiver the power rating of the reaction potentiometer needs to be checked. Allow a 2 mA current flow through it. The series resistor must be selected so that the screen voltage can be varied from zero up to about 65 V.

For the tuning reduction drive I employed a 2" diameter drum and cord, with the tuning knob on a ¼" diameter shaft reduced to 3/16" so the cord would not wander (See Figure 6). A drive reduction of 10:1 is achieved. The bearing for the ¼" shaft and knob was taken from an older style potentiometer.

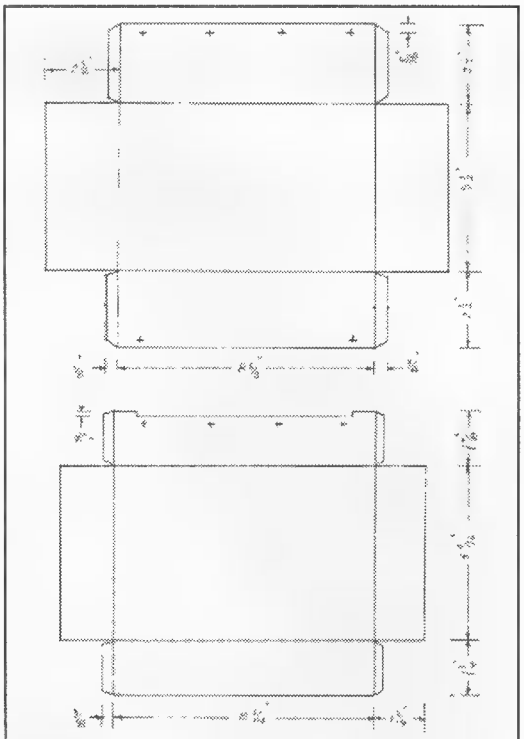


Fig 4. Box construction from 18g zinc plated steel. Holes to suit piano hinge selected

The receiver tuning capacitor is mounted on a separate plate (See dotted outline in Figure 3 and also Figure 6), attached to top panel by bolts and spacers, these being on a radius greater than the 2" drum so there is no interference. Since the tuning capacitor will normally only have a short shaft an extension shaft is needed to take it though the top panel and allow the 3" tuning dial and knob to be added.

The output choke should have an air gap so the standing plate current does not cause saturation. I used a small speaker transformer from a valve B/C receiver. Although I removed the secondary winding, this is not necessary and it can be used so the set can drive modern low impedance headphones.

My choke/transformer was a little too large to mount on the underside of the top panel, between the phone jack and tuning knob and so was mounted with one side fixed to the tuning capacitor plate and the other to the top panel with a stand off spacer (See Figure 7).

The three pin Jones plug and socket for connection to the external power supply was the most difficult component to locate. A 4 pin plug and socket is much more common and can be used.

The two air coil formers, both 1" in diameter and about 2" long were also

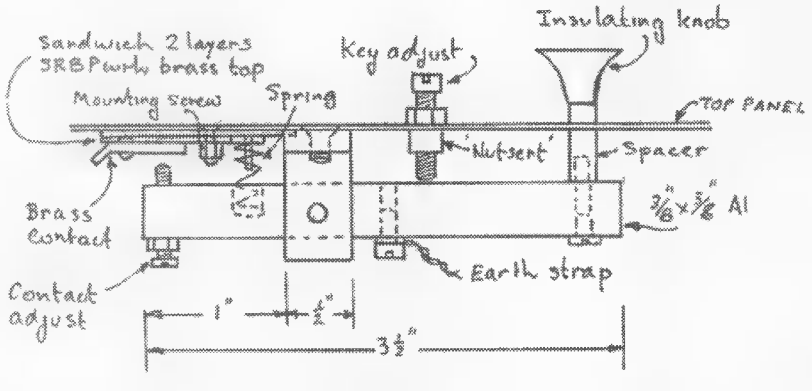
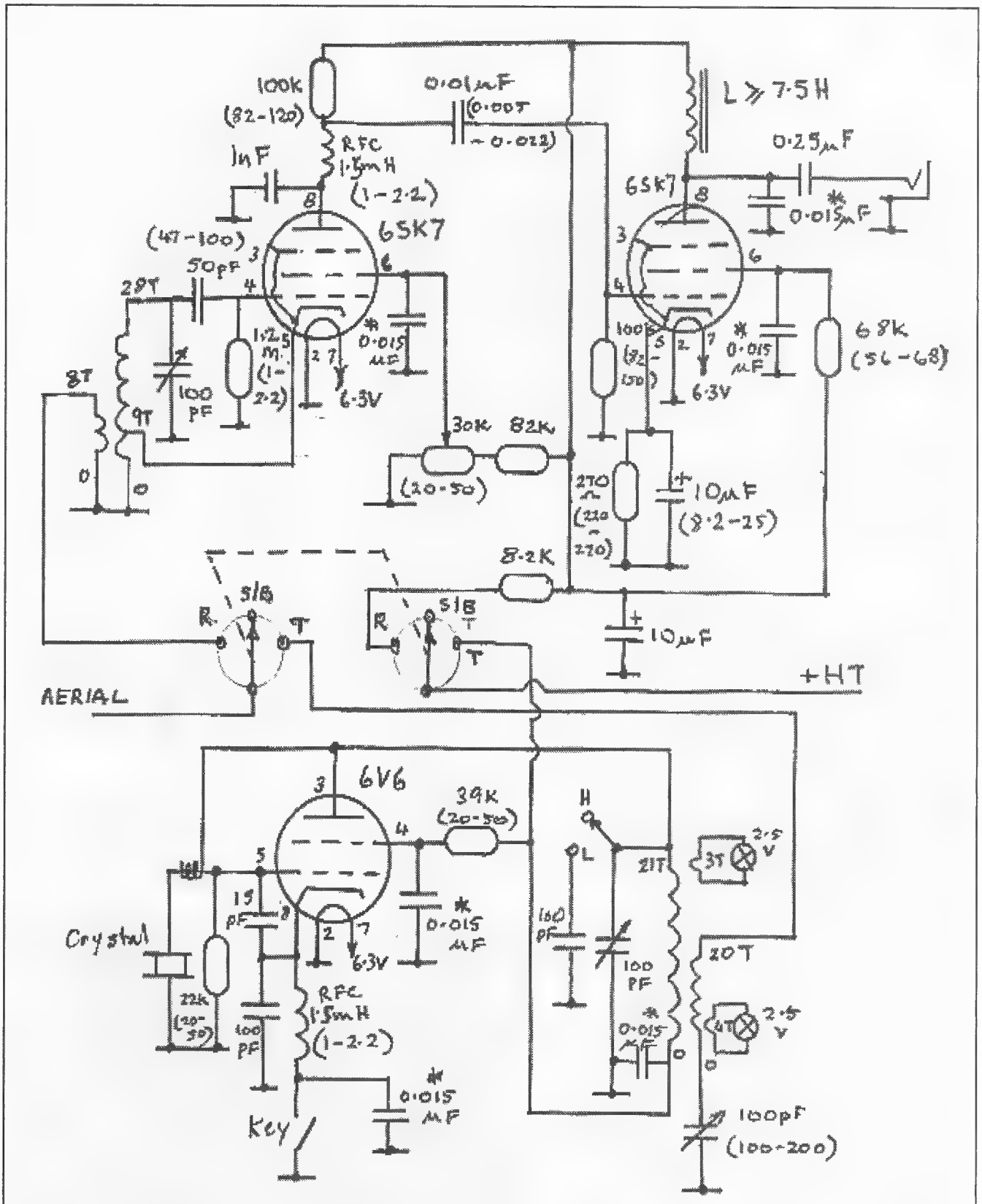


Fig 5 Morse key (not to scale see note 1) Plan view in Fig 7



Circuit schematic of the Paraset

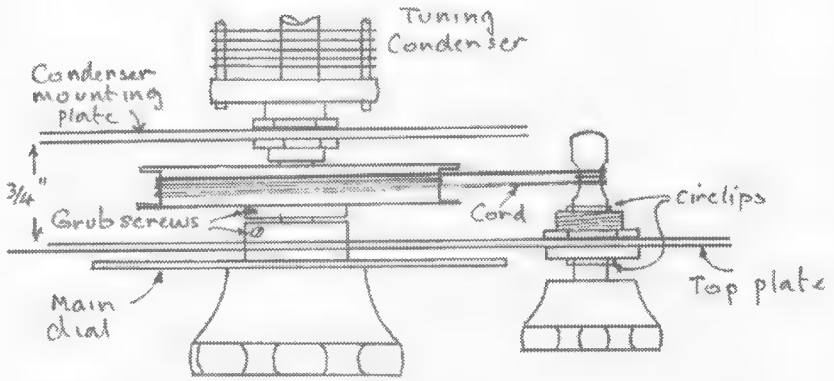


Fig 6 (not scale, see note 1) Drive reduction 2" drum 3/16 shaft giving 10:1 reduction

from a B/C receiver and rewound as shown in Figure 8.

The lugs at the top of the coil were made from wire wrap pins. The receiver and transmitter coils were close wound using 0.5 mm enamelled wire for the receiver and 0.8 mm for the transmitter.

The two lamp windings were wound with 0.25 mm enamelled wire, wound on top of the tank and aerial windings at the respective coil ends (Figure 8.

Figure 9 shows the completed top panel. Note the types of knobs used for the bottom row of controls, including the Morse key. The panel and box were spray painted "Dusk Grey" with the lettering either screen printed in black or painted by hand. If the latter I find it easier to use an old fashioned split nib ink pen than a fine paintbrush. The small brass plate (1 3/16" by 3/8") has Serial No. followed by a four digit number stamped on it. It is mounted using two 8BA screws.

5. Testing

Plug in the transmitter 6V6 valve. Turn the function switch to standby (filament voltage only applied) and ensure the valve heats up.

Next switch the function switch to transmit, applying the high voltage supply (if you can start with a lower voltage value do so) and the HT current should not be more than about 50 mA when the key is depressed.

Insert a crystal and check with a CRO, frequency counter or receiver that the circuit is oscillating when the key is pressed.

Tune the plate circuit and peak the tank indicator lamp (HT current will dip to 15-20mA. Also increase the HT voltage to 250V and the lamp brilliance should increase). If an aerial or load (capacitive) is attached then tune the aerial circuit by peaking the aerial lamp. At the same time the tank circuit lamp will dim as energy is coupled out of the circuit.

Plug in the two 6SK7 valves and check that both warm up when the heater voltage is supplied (Function switch on standby). Turn the regeneration control anticlockwise so on power up there will be zero volts on the screen grid of the regenerative detector valve. Switch to receive, thus applying the HT supply. Faint mains hum should be heard in the earphones. The HT current should be a few mA. Increase the regeneration until a strong hissing noise is heard, being the onset point of regeneration. Any further reaction the receiver breaks into oscillation. Tune across the receiver band and ensure that by adjusting the regeneration control there is always a position where regeneration smoothly occurs. Connect an aerial (or signal generator) and ensure the receiver operates correctly across the whole band. Should there be a drop out point for regeneration then the resistor in series with the regeneration control may need reducing or the cathode tap on the coil be increased beyond 10 turns.

6. Conclusion

The set is simple and works well. It should give hours of satisfaction on air as well as being a set to put on display – a replica of a famous WW II transceiver used by the SOE and MI 6.

7. References

1. Lorain P, *Secret Warfare, The Arms and Techniques of the Resistance*, (First published in French in 1972 and adapted to English by David Kahn), Orbis Publishing, London 1983.

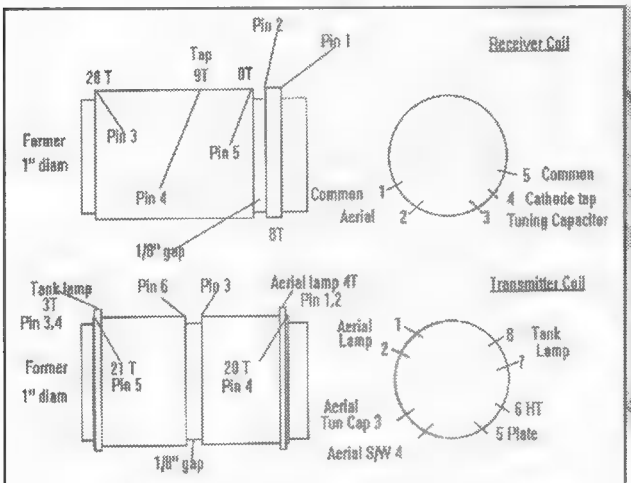


Fig 8 Receiver and transmitter coil winding details, including terminations

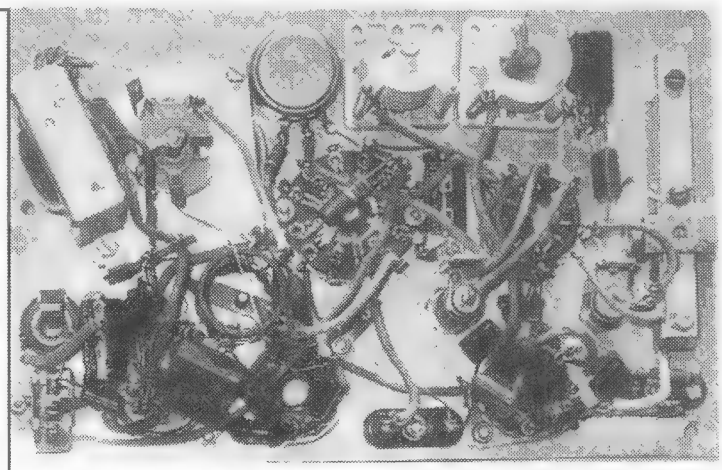


Figure 7. Underside top panel showing component wiring.

Also published in the US as: *Clandestine Operations. The arms and techniques of the Resistance, 1941-1944*, (Adapted by D Kahn) MacMillan Publishing Co, New York, 1983.

2. Ladd J and Melton K, *Clandestine Warfare. Weapons and equipment of the SOE and OSS.* Blanford Press, London, 1988. See Appendix 3, Table of Section 7.
3. Hawker P, *Clandestine radio – the early years, Parts 1 and 2*, "Wireless World" Vol 88 Nos 1552 and 1553 (Jan/Feb 1982)

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Notes:

1. Some mechanical drawings are reduced in size (Figs 3, 4, 5, 6 & 8). A larger copy is available on request from the Editor in hard copy or as an Acrobat (pdf) file. (Ed.)
2. For newer Amateurs unfamiliar with Imperial measure, one inch (1") = 25.4 mm (Ed.).

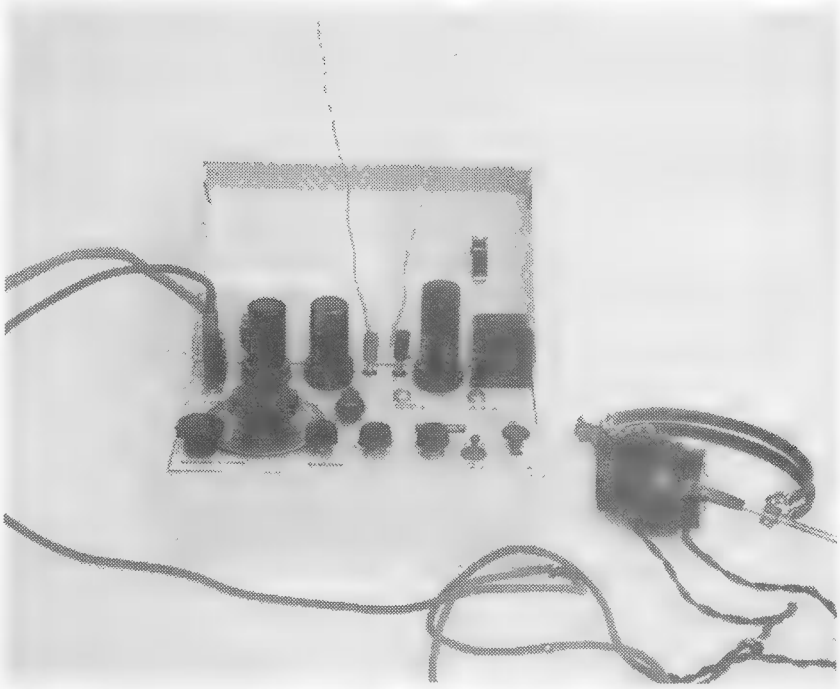

Figure 9. Top panel of the Paraset showing labels and knob styles.

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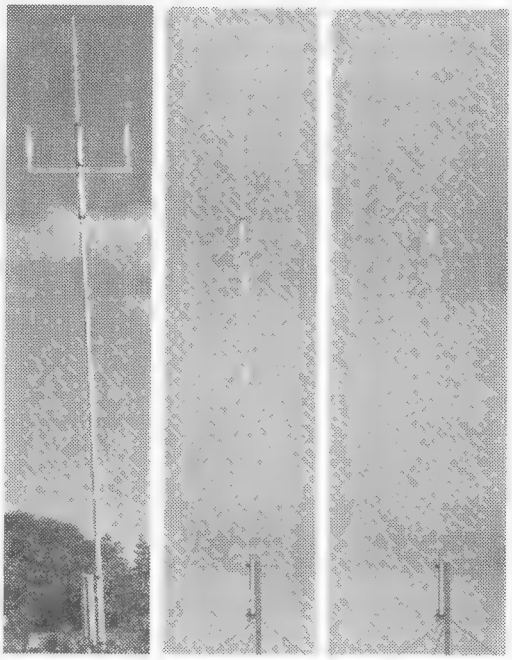

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Specifications

Antenna	TEV-4	TEV-3	TEV-3 Warc
FREQUENCY	7, 14, 21, 28 MHz	14, 21, 28 MHz	10, 18, 24 MHz
ELEMENT HEIGHT	4090 mm	3800 mm	5025 mm
FEED IMPEDANCE	50 OHM	50 OHM	50 OHM
MAX. RADIAL LENGTH	10.7 Meters	5 Meters	7.5 Meters
SWR	1.5 or less	1.5 or less	1.5 or less